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OF THE

Mineralogical Society

OF

GREAT BRITAIN & IRELAND

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THE MINERALOGICAL SOCIETY

Mineralogical Society of Great Britain & Ireland.

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Royal Society of New South Wales, *Sydney.*
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Société Géologique de Belgique, *Liege.*
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Academy of Sciences, *Philadelphia.*
Società Toscana de Scienze Naturali, *Pisa.*
American Journal of Science. *Newhaven.*
Zeitschrift für Kryst. und Min., *Strasburg.*
Soc. Mineralogique de France, *Paris.*
Soc. Scienti Argentina.
Min. und Pet. Mittheilungen, *Vienna.*

Exchanges of a kindred character are invited from other Societies and Editors.

EXCERPT MINUTES OF COUNCIL MEETING.

Held at the Masonic Hall, Sheffield, on Friday, August 22nd, 1879.

H. C. Sorby, F.R.S., in the Chair.

The following gentlemen were elected as Ordinary Members,—

Mr. S. Gorman Burn, of Central City, Kansas, U.S.A.
Mr. W. R. Hodgkinson, of the Royal College of Chemistry, South Kensington.

The Report of the Council as drafted by the Secretary was modified and approved.

FOURTH ANNUAL GENERAL MEETING,

Held at the Masonic Hall, Sheffield, on Friday, August 22nd, 1879,

H. C. Sorby, F.R.S., in the chair.

The following Report was read by the Secretary.

COUNCIL REPORT, 1879.

Once more we have the pleasure of congratulating the Members on the continued prosperity of the Mineralogical Society, notwithstanding the losses which it has sustained by deaths and by withdrawals. During the year which is just concluded, 14 corresponding members, 16 new ordinary members, and 6 associates have been elected; on the other hand the Society has lost four members—Professors Harkness and Nicol, Mr. Wm. Vivian, and Mr. W. R. Williams,—by death; and several members by removal or withdrawal. The present strength o the Society is as follows:—

Corresponding Members	24
Ordinary Members	124
Associates	24
	172

The corresponding number last year was 163.

Our financial position is good, as was shewn by the balance sheet lately issued in the Magazine. This shews a balance of assets over liabilities amounting to £85 10s. 11d, besides a sum of £118 3s. 0d., invested in 3 per cent. Consols; together amounting to £203 13s. 11d. The corresponding balances last year amounted to £144. The credit balance is exclusive of the value of the considerable stock of Magazines in hand at the end of 1878.

The second volume of the Mineralogical Magazine has been completed since our last annual meeting. It is even more valuable than its predecessor, although the council has still to regret that the contributors to its pages of original papers are so few. The Society is especially indebted to Professor Heddle for his valuable papers on the Mineralogy of Shetland, and for his excellent Geological and Mineralogical Map of the Shetland Islands.

Dr. H. C. Sorby now retires from the Presidential chair, after more than three years of most valuable service, but the Council will still have the advantage of his advice and assistance as the first of its past Presidents.

We have now to recommend the election of Dr. M. Forster Heddle, of St. Andrews, as his successor.

His election will vacate one of the Vice-Presidental chairs, and we propose as his successor, Prof. T. G. Bonney, of St. John's College, Cambridge. Messrs. Church, Drew, Duncan, and Archibald Geikie retire by rotation from the Council, and the election of Prof. Bonney as Vice-President will create a fifth vacancy.

To fill up these vacancies we propose the election of the following gentleman as Members of Council.

Mr. R. H. Scott.
Dr. Thos. Aitken.
Prof. T. Mc. Kenny Hughes.
Prof. Alexr. Crum Brown.
Mr. T. W. Miller.

For the remaining offices we propose the re-election of Dr. C. Le Neve Foster, as Foreign Secretary; Messrs. F. W. Rudler, and B. Kitto, as Auditors; and Mr. J. H. Collins, as Secretary.

By the gifts of Members, and by exchanges with kindred bodies, the Society is gradually accumulating a valuable Mineralogical and Petrological Library. A List of the books which are now available for the use of Members—and which may be obtained on application being made to the Secretary—will be published in an early number of the Mineralogical Magazine.

In conclusion we would again urge all Members and Associates to use their influence to increase the numbers and promote the prosperity of the Society.

The report was adopted, *nem. con.*

The following papers were read—

On the production of different secondary forms of crystalline minerals, by H. C. Sorby, F.R.S.

On some Peridotic rocks from the island of St. Paul's, by Rev. A. Renard.

On some Cornish Serpentinous rocks, by J. H. Collins, F.G.S.

On some old Rhyolites from Jersey, by T. Davies, F.G.S.

On some artificial crystals isomorphous with Olivine, by A. E. Arnold. Communicated by J. H. Collins, F.G.S.

Remarks on the Minerals of Cyprus, by J. H. Collins, F.G.S.

The following papers were taken as read—

On the Minerals of the Hornblendic Gneiss of Sutherland, by Prof. M. F. Heddle.

On some Minerals from the Mawddach Valley, North Wales, by T. A. Readwin, F.G.S.

On a curious form of Coal from South Wales, by Jas. S. Merry.

The meeting was concluded with cordial and unanimous votes of thanks to the proprietors of the Masonic Hall for the use of the meeting room, and to Dr. Sorby for his conduct in the chair.

BOOKS RECEIVED.

From *Prof. J. D. Dana*, Newhaven. American Journal of Science.—July to October, 1879.

„ *Prof. D'Achiardi*, Pisa. Atti della Soc. Tosc. di Sci. Nat., Vol. IV. fasc 1.

„ „ „ Atti della Soc. Tosc. Proc. Verb. LXXXIX to CXXXI.

„ *Prof. Rammelsberg*, Berlin. Ueber das Verhalten fluorhaltiger Mineralien in hoher Temperatur, inbesondere der Topase und Glimmer.

„ „ „ „ Ueber die Zusammensetzung der Lithion-glimmer.

„ *Prof. Tschermak*, Vienna. Min. und Pet. Mittheilungen, Band I, Heft 1 to 6.

Do. do. do. Band II, Heft 3 and

From *Prof. Tschermak*, Vienna. Die Clintonitgruppe

„ „ „ Die Glimmergruppe, Theil. 1, 2.

„ *Reale Comitato Geologico*, Rome. Bolletino, 5 to 8, 1879.

„ *Prof. Geinitz*, Dresden. Fuhrer durch das K. Mineralogische-Geologische Museum in Dresden.

„ *Prof. Groth*, Strasburg. Zeitschrift fur Kryst und Min. Band III. Heft 5 and 6 Band IV, Heft 1.

„ *Dr. Theodor Wolf*, Guayaquil, per *G. Vom Rath*. Ein Besuch der Galapagos Inseln.

„ *R. J. Harrington, PhD.*, Montreal. Report on the Minerals of the Apatite-bearing veins of Ottawa Co.

„ *Prof. G. Vom Rath*, Bonn. Vorträge und Mittheilungen.

„ „ „ Natur Wissenschaftlicher Studien an die Pariser Weltanstellung, 1878.

„ *Dr. Theodor Kjerulf*, Christiania. Udsigt over det Sydlige Norges Geologi, mit Atlas.

„ *Soc. Min. de France*. Paris. Bulletin, Vol. I, Nos. 1 to 8.

„ „ „ Vol. II, Nos. 1 to 6.

„ *Soc. Scient. Argentina*. Trans., Vol. VIII, Nos. 1 and 2.

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No. 14. OCTOBER, 1879. Vol. III.

XII.—*On the cause of the production of different secondary forms of crystals.*

By H. C. Sorby, LL.D., F.R.S.; President G.S., &c.

IT has often struck me that much more might be learned from the study of the secondary forms of crystalline minerals than we now know respecting the circumstances under which they were produced. Some years ago being chiefly acquainted with calcite as it occurs in Derbyshire, where the crystals are usually of the so-called dog-tooth shape, my attention was much attracted by the difference in the form of the crystals in Devonshire and Cornwall, where we so often meet with six-sided prisms. On reflecting on this difference I could not give any more satisfactory explanation than that the conditions under which they were formed must have been very different in some important particular. Various experiments, made both before and afterwards, sufficed to indicate at all events some of the possible causes of such a difference in the form of this mineral, but at the same time showed clearly that much special research would be required before we could draw such definite conclusions as could be desired. I feel that the facts I now propose to describe are very imperfect, but yet for a long time have wished to say something about them, if only to lead others to work out the subject more completely.

My first experiments were made with carbonate of lime. I prepared aqueous solutions of this substance in carbonic acid, and evaporated them at various slightly different temperatures. I also evaporated in a similar

manner solutions containing in addition to carbonate of lime, small quantities of the carbonates of iron and of magnesia. It soon became apparent that the number of varying forms that could thus be prepared was very great, but I did not not continue the experiments sufficiently to enable me to draw any complete detailed conclusions. I however convinced myself that small differences in temperature, and the presence of small quantities of foreign substances were sufficient to give rise to very varying secondary forms in the crystals, and not only so, but that the conditions under which they were formed—for example whether at the surface or at the bottom—had also an important influence. Some of the results had a direct bearing on mineralogy, and sufficed to explain the cause of the production of certain characteristic crystals. Thus, for instance, the presence of a small quantity of magnesia, gave rise to crystals of the rhombohedral shape, so commonly met with in limestones containing much magnesia.

Some time after this I was engaged in studying the fluid cavities met in chloride of potassium, and for this purpose prepared many crystals by slow spontaneous evaporation. At first I obtained some solid, partially transparent cubic crystals, very suitable for my purpose, but afterwards, when using the same material. I was unable to obtain more crystals of the same character, which I was very anxious to do. On the contrary every time that I prepared a fresh crop, I obtained crystals differing not only from those first made, but also from one another, all of which I carefully preserved, until I had got a most instructive collection. The only explanation I could give of the facts was that during the time when I was making these experiments the temperature of the atmosphere had slowly changed, and that the production of all the various forms of the crystals obtained had depended upon a comparatively small variation in the temperature.

In preparing for microscopical purposes crystals of other substances, I have in some cases remarked no such tendency to vary, but in other cases have been completely unable to procure a second time crystals of a particular character. Thus, for example, I was once able to make some excellent thin, flat, rhombic plates of chlorate of potash, coloured with permanganate, and being most excellent spectroscope objects I was anxious to procure more of them. I endeavoured to do so over and over again, and though I prepared many hundred crystals, I could never obtain any more of the same plate-like character, nor could ascertain what had been the peculiar conditions under which they had been formed.

I cannot doubt that such facts as these must have been often noticed before, though they may not have attracted such particular attention. I cannot but think that good service might be done to the science of miner-

alogy by anyone who would adequately devote his attention to this kind of enquiry. The facts which I have described are so limited in their range that I feel almost ashamed to draw attention to them, but yet I think they serve to prove very clearly that, independent of the rate of deposition, comparatively small difference in the temperature of the water, and the presence of small quantities of other substances, may cause such a marked difference in the general form and character of the crystals of a substance deposited from it, as would serve well enough to explain the production of the varying secondary forms of natural minerals. Possibly this will readily be admitted, but a much more difficult question then arises, which is to correlate the known secondary forms with the unknown conditions under which they were produced. If this could be done, it would, I doubt not, be a great gain for geology, and would throw much light on many interesting questions. I see no reason why we should not learn as much from the detailed study of minerals as we have learned from the detailed study of fossil organisms.

XIII.—*Note on a Crystallized Slag isomorphous with Olivine.*

By A. E. Arnold.

Communicated by J. H. Collins.

THE crystals referred to were found in considerable quantity in the slags produced in Mr. Hollway's experiments on the reduction of metallic sulphides at Penistone, in July 1878.

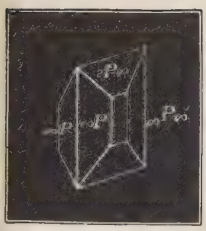
The experiments were carried out with ordinary Bessemer plant. Upon running the molten mass from the ladle into one of the ingot moulds the slag ran in a thick stream of perfect continuity, falling without noise a distance of some feet into the liquid portion below. The crystals occurred lining cavities in the partially cooled slag from which a portion of the molten material had been withdrawn.

Some of them were extremely well formed and they varied in size from about 1-100th to $\frac{1}{4}^{th}$ of an inch in length, and somewhat less in breadth and thickness.

After careful separation from contiguous substance the crystals were analysed in duplicate with the following results,—

	I	II	Calculated on 13 $\left\{\begin{matrix}FeO\\FeS\end{matrix}\right\}$ 7 SiO_2
SiO_2	28·99	29·06	29·08
FeS	.. ..	6·10	6·09
FeO	.. ..	61·34	64·82
Al_2O_3 ..	.. ..	60	
Cu	.. ..	14	
MnO, ZnO ..	.. ..	2·78	
		100·02	99·99
Sp. Gr	4·19	4.22	

By adding together the basic oxygen and half the sulphur the sum is found to equal the oxygen of the SiO_2 showing that the presence of FeS cannot be accidental. If the analyses of slags I, II, III, V, of the July, 1878, Penistone experiments be similarly calculated into basic and acid oxygen, the fact is revealed that the sulphur takes part as a basic element in the constitution of the slag, so that we really have a silicate of a metallic sulphide.



Some of the crystals referred to have been examined by Dr. C. O. Trechmann, of Hartlepool, who states that they exhibit the forms shewn in the figure. He considers them to be artificial Fayalite, regarding the FeS present as a mere mechanical admixture, but its large quantity, and its proportion, *exactly* replacing one molecule of the ferrous oxide would seem to indicate that it is a true chemical compound. It differs from the mineral Helvin not only in crystallization but in having two atoms of metal to one of silica, whereas the latter contains seven of metal to three of silica.

I have tried the artificial formation of sulphosilicates, by passing H_2S over metallic silicates. With 2 FeO SiO_2 I have not yet succeeded, the result I obtained being

$$2FeO\ SiO_2 + 2H_2S = 2\ FeS + 2H_2O + SiO_2$$

which is somewhat interesting.

The existence of sulphosilicates of iron was first suspected by Leplay, but he was unable to prove the hypothesis he enunciated. He observed that slags produced in the smelting of copper ores by the Swansea process invariably contained more sulphide of iron than could be accounted for by the presence of entangled regulus. The following examples may be cited to show how certain metallic sulphides may play the part of basic oxides in these artificial silicates. In the Penistone experiments crystalline homogeneous slags were produced of the orthosilicate type, which should contain therefore equal quantities of oxygen in acid and basic combination according to the formula $2M''O, SiO_2$. Now it appears from the analyses made by Mr. J. E. Stead and myself that there is a slight deficit in the amount of the basic oxygen which is almost exactly compensated for by adding to it half the percentage of sulphur (O = 16 replaced by S = 32) found to be present.

In the following analysis by Mr. J. E. Stead, it will be seen that the total oxygen found in the bases amounts to 14·382 per cent. In the operation in which this slag was produced the regulus obtained contained 15·8 per cent. of copper and 21·96 per cent. of sulphur. Casting out by means of these data the amount of sulphur present as regulus in the slag estimated on the 0·16 per cent. of copper present, we find we have to subtract 0.223 per cent. of sulphur from the sulphur found; 3·39 per cent − ·223 per cent. = 3·167 per cent. which represents the sulphur replacing oxygen in the sulphosilicate. The equivalent of this in oxygen is 1.583 per cent.

Iron Protoxide	53·30%	Oxygen =	11·844%	
„ Peroxide	3·00	„ =	0·900	
Iron comb. with Sulphur	5·79			
Copper „ „ „	0·16			
Lead	0·12			
Zinc Oxide	1·15	„ =	0·269	14·382%
Arsenic	trace			
Manganese Oxide ..	0·32	„ =	0·071	
Alumina	2·15	„ =	1·000	
Lime	0·40	„ =	0·114	
Magnesia	0·46	„ =	0·184	
Sulphur	3·39			
Silica	29.90	Oxygen =	15·933%	
	100.14			

Basic oxygen present	14·382%
Basic sulphur „ Calculated into oxygen	1.583 „
	15·965%

The oxygen calculated from 29·90% SiO_2 = 15·933%

Similarly in a second analysis by the same analyst analogous results are obtained on calculation.

Iron Protoxide	54·62%	Oxygen =	12·138%	
„ Peroxide	3·71	„ =	1·113	
Iron comb. with Sulphur	4·27			
Copper „ „ „	0·22			
Lead	0·10			
Zinc Oxide	1·75	„ =	0·348	14·927%
Arsenic	trace			
Manganese Oxide ..	0·37	„ =	0·082	
Alumina	0·06	„ =	0·960	
Lime	0·37	„ =	0·106	
Magnesia	0.45	„ =	0·180	
Sulphur	2.55			
Silica	30·05	Oxygen =	16·027	
	100·52			

The regulus produced contained 16·6 per cent. of copper and 23·5 per cent. of sulphur: 0·22 per cent. of copper in slag corresponds to ·311 per cent. reguline sulphur.

Total oxygen of Bases	14·927%
Oxygen replaced by Sulphur $= \frac{2{\cdot}55 - {\cdot}311}{2}$	1·119
	16·046%
Oxygen of Silica	16·027%

It is probable that sulphur exists in blast and puddling furnace slags in the form of sulphosilicate. It is well known that manganese exercises an affinity for sulphur in the presence of silicious fluxes, which calls to mind the fact that the only natural sulphosilicate known is that of manganese.

XIV.—*Preliminary Note on old Rhyolites from Bouley Bay, Jersey, &c.*

By Thos. Davies, F.G.S. of the Mineral Department, British Museum.

THE examination of the rhyolite exhumed by Dr. Henry Hicks, F.G.S., from the conglomerate of the Pebidian formation of St. Davids, Pembrokeshire (*Quart. Journ. Geol. Soc., May.*, 1878, p. 153), recalled to my mind certain rocks from other localities which had found a place in the large and important petrological collection in the British Museum, which I thought might prove to belong to the same group. Among these, some fragments brought from Bouley Bay, Jersey, by Wm. Carruthers, Esq., F.R.S., whose attention they attracted, interested me especially. It was found, however, that they had not been collected with the view of illustrating the rock in all its varieties, so further examination was postponed until an opportunity occurred to procure more material.

To the kindness of Dr. Andrew Dunlop, F.G.S., of Jersey, I am now indebted for a selection from his own collection of such pieces as he considers will afford a sufficient representation of it in all its varied aspects.

The names "hornstone" and "hornstone porphyry" by which these rocks have been designated, sufficiently suggest their general aspect, but the spherular character of a considerable portion of it appears to have escaped the observation of previous writers.

The revelations of the microscope confirm in the most conclusive manner the view derived from a macroscopical examination. They are true rhyolites, although the subsequent alteration they have undergone through devitrification and the effects of hydrothermal agencies, are in some parts very considerable. Yet the perlitic and spherulitic structures so well exhibited by some of the younger outflows are preserved, the former shewing as distinctly as in their modern representatives. The spherular development is, however, in most cases, much more marked in these older rhyolites than in their younger equivalents, this structure varying from minute spherular groupings without a peripheral definition to distinct bodies easily separable from the mass, which vary in size from that of a pea to over two inches in diameter. Sometimes they occur developed in parallel bands resembling those in the obsidian of the Lipari Islands, but usually they are irregularly distributed through the mass. Occasionally

the perlitic and spherulitic structures are combined, thus supplying undoubted evidence of their original vitreous condition.

Dr. Dunlop informs me that these rocks extend from Bouley Bay across the N.E. corner of the island to St. Catherine's Bay. To the N.E. they are overlain by a conglomerate or rather breccia, which consists largely of the shale forming a large part of the island, with some syenite (probably hornblendic granite); but that near the rhyolites fragments of these are very frequent in it. He also points out that at Anne Port, forming the S. point of Saint Catherine's Bay, the Bouley Bay rocks appear to pass into a "porphyry." This, on examination is resolved into a quartz felsite, and it affords additional evidence of a view I have for some time entertained as to the identity of composition, structure, and origin of a large part of the quartz felsites with the modern rhyolites.

To this group belongs some fragments of a boulder given to the Museum by Spencer G. Perceval, Esq., which formerly existed near Old Cleeve, Somerset, in which the spherules are as large as a cricket-ball, and the mass of which exhibits the fluidal structure in a marked manner. Another rock from the drift at Hartlebury Common, Worcestershire, also collected by Mr. Perceval, belongs here.

Detailed descriptions of all these rocks now in course of being worked out, together with some notes upon the relations of the quartz-felsites to the rhyolites, will form the subject of a communication to the next meeting of the Society.

XV.—*Note on the Minerals of the Island of Cyprus.*

By J. H. Collins, F.G.S.

I have lately had the opportunity of conversing with one of our members, Mr. Jos. Jewell, who has been making an inspection of some parts of the island of Cyprus for mining purposes, and having been called upon by other parties to report on a number of mineral specimens brought from that island, I have thought that a short note on the subject might be of some interest to the members generally.

So much has been said of the mineral riches of the island, that I was astonished at the comparative poverty of the specimens brought home, and also at the very small number of mineral species which the island has so far yielded. It is indeed evident that large quantities of ores have been worked in the island in former times as is shewn by the extent of some of the excavations and by the immense heaps of slag described by M. Albert Gaudry, but no rich deposits seem to be in existence now, so far as is yet known. With regard to the excavations at one of the principal localities, that of Bellahousa, Mr. Jos. Jewell reports as follows:—

The mountain in which the copper-ore is found consists of more or less decomposed limestone intermixed with layers of red and yellow ochre, and containing several bands of porphyry and small veins of iron pyrites.

The mines are approached by a deep and narrow valley which runs up direct from the sea-shore. In No. 1 mine on the south side of the valley two levels are driven into the mountains for distances of 3 and 15 fathoms respectively. These open into large chambers which have been excavated in a mixed "conglomerate" of black earthy matter containing masses of limestone, blue and green carbonate of copper, and sulphate of iron, together with layers of sand and pebbles. No. 2 mine is also entered by a short level, and consists of chambers excavated in a similar black earthy mass. Some of these chambers are 80 feet long, 60 feet wide, and 20 feet high. These "conglomerates" contain from 2 to 3 per cent of copper, but of course the parts worked away may have been much richer.

The limestone hills on the north side of the valley contain a large quantity of red and yellow ochre containing from 1½ to 3 per cent. of copper, together with some particles of blende. By sinking pits in this mass some small lumps of carbonates of copper were found, yielding from 12 to 14 per cent of copper.

Somewhat further up the valley is a mine which has been worked in a mass of iron pyrites containing a small proportion of copper. In the same mountains, at some little distance, is a large deposit of black oxide of manganese.

It is difficult to see how such poor ores could be worked by the ancient miners of Cyprus, unless an abundance of fuel were obtainable. Had there been forests no doubt such free smelting ores might have been worked to considerable advantage. It is clear, however, that such ores will not pay for smelting now by the Welsh process, and not being pyritous ores they will not be adapted for the Hollway process unless they are worked in connexion with the large deposit of pyritous material above referred to.

The following list gives the names of all the mineral species of the island which have been observed up to the present time, so far as is known to the writer:—

List of Minerals found in Cyprus.

Serpentine. Mount Troödos,
Saussurite } in Gabbro, ,,
Diallage }
Hematite. Lesso. Lithrodonta, Hai Héracliti, Stavio Vormi, &c., (Specular Iron.)
Limonite. Many localities, G.
Pyrites. Dginhoussa and many other places.
Melanterite. Dginhoussa.
Peroxide of Manganese. Visatchia, and Acoutzo, G.
Jasper.
Rock Crystal
Malachite.
Chessylite.
Chalcopyrite.
Gypsum.
Chrysocolla.
Allophane.
Cyanosite.
Melaconite.
Titaniferous Iron Ore.
Galena.
Blende.
Calamine.
Analcime (Cyprian diamonds).

XVI.—*Notes on some Minerals of the Mawddach Valley.*

By T. A. Readwin, F.G.S. &c.

THE late eminent palæontologist, Mr. Salter, F.G.S., characterized the portion of the lovely valley of the Mawddach, at, and near the Falls of the Cain and Mawddach Rivers, "a perfect geological puzzle."

Certain it is, that touching Tyddyngwladus, the survey maps are greatly at fault; and, that the rocks, thereabouts, most of them, are of *pre-cambrian* age.

Dr. Hicks, F.G.S., has hit upon the truth, approximately, I think, in what he calls *Dimetian* at St. David's, (as applied to the lowest beds of this district.)

After more than a year's unceasing investigation of these puzzling rocks and their associated minerals (chiefly with reference to the modes of occurrence of the "precious metals"). I must frankly acknowledge that the locality geologically, to my comprehension, remains pretty much as Salter left it, a "puzzle."

I am quite content to leave the exact order of superposition of these rocks in the hands of the geologists; and, will briefly state that the hand-specimens I have collected show:—

Black micaceous and talcose schists; black and green shales; hard, dark-grey, felspathic, ashy, and cindery-looking uncleavable (for the most part,) slates; (*lower silurian* of the survey). Black slates, (*upper cambrian* or *lingula-flags* of the survey). Felspathic and "Trappean" grits; hard coarse sandstone; rough schists, shales and slates (*lower cambrian* of the survey.)

Portions of felspathic-lava beds; striped cinder-beds, both chloritic and mixed with grit and sandstone; spotted, blotched, felspathic, sedimentary and interbedded "trap-rocks."

Bits of ashy-beds, yellow clay, "Elvan," "Flookan," and quartzite.

The usual "intrusive greenstones" of the survey, which are green, grey, and reddish in colour, fine, medium, and coarse-grained, often very coarse-grained, prominently quartzose, and, prominently hornblendic; also, diabase, and diorite, and the "magnificent uralite porphyry."

The minerals include compact and crystallized baryte, calcite (sparsely), orthoclase, chlorite, black hornblende, white scaly mica, white, yellow,

ferruginous, calciferous, auriferous, plumbiferous, zinciferous, cupriferous and pyritous quartz, with the cherty or hornstone variety abounding, which is often powdered (so to speak) with extremely fine gold, all of which is so light that it will float on water. Talc also, occasionally, and uralite. Native gold, native silver, native antimony, native copper, galena, copper pyrites, iron pyrites, mispickel, marcasite, rhodochrosite, tetrahedrite, polytelite (of D. Forbes,) pyromorphite, blende, stibnite, senarmontite, berthierite (?), aphthonite (of Glocker ?), earthy malachite, platinum (?), titanoferrite (of Forbes), &c.; some interesting particulars of which I reserve for other occasions.

Gold is found *in situ* in the metallic state, of a very pale yellow color. As yet, it has not been found in anything approaching geometric forms of crystallization. Generally, the gold is disseminated in whitish crystalline quartz, or in hornstone, in a state of division so minute as to be scarcely discernible by the aid of a powerful lens. Occasionally, this precious metal is found something like what Sir R. Murchison characterised as "crystallised twigs." This gold as found answers to *Pliny's* "electrum," containing from 10 to 15 or more per cent of combined silver.

Much has been said about 'derivative forms' of gold; but from a long series of observations, I cannot be persuaded to believe in derivative forms, touching systematic crystallization. I believe, rather, that gold, hereabouts, is frequently contained in quartz in a *non-metallic* state; and that, in process of time, be it short or long, particles of gold in ever-varying shapes (not definite forms) increase palpably in size and weight, even in and upon quartz apparently wholly destitute of the ordinarily associated metallic sulphides.

I have treated this subject at great length in a former number of the Mineralogical Magazine.*

Some of the specimens described in that paper, have since given me ample proof that I am altogether in the right about it. And recent repeated analyses convince me too, that gold exists here in a state of sulphide, and *probably* in some other state, or states, not yet generally known.

The electrum here, is frequently in quartz more or less surrounded with galena, blende, iron pyrites, copper pyrites (chalcopyrite of *Dana*), mispickel, (arsenopyrite of *Dana*) marcasite! But chiefly with galena and blende, and a proustite-looking mineral, an exceptional condition of blende.

I have treated many specimens of galena in quartz with hot acids, got rid of the sulphide, and obtained the electrum theretofore enclosed within

* No. 5, p. 158.

it, growing, as it were, out of the quartz, which could then, sometimes, become easily detached.

I have some reason for believing that the galena in such cases is the more recent mineral-aggregate.

I find, also, electrum in argentiferous galena, altogether unassociated with quartz, or other metalloid.

I find bits of gold of several grains weight in the sand and silt of the River Mawddach.

This stream-gold is worth 5s. an ounce more than the electrum which is found diseminated throughout the lode-stuff generally.

I gave my friend the late D. Forbes, F.R.S., a goodly sample of this stream-gold, and the following is what he wrote of it.

"The portion received contains the native gold in the form of small flattened, elongated spangles, in size from about a pinshead, down to almost dust, and of a rich yellow colour; it was accompanied by abundance of fine black sand, supposed to be magnetic oxide of iron, from its being strongly attracted by the magnet, but which, on analysis turned out to be titanoferrite. It also contained small particles of quartz, slate-rock, mica, and some small cubes of iron pyrites and galena.

The specific gravity of the gold, carefully separated from any other admixture, was found to be 15·79 at 60°F.; quantity employed 22·75 grs.

20·16 grs. afforded 17·71 grs. metallic gold; 3·89 grs. chloride of silver; 0·09 gr. insoluble quartz; and, 0·10 gr. sesquioxide of iron.

The results when calculated give :—

Gold..	17·71	=	84·99
Silver	2·92	=	13·99
Iron	0·07	=	0·34
Quartz	0·09	=	0·43
Cu & Loss	0·07	=	0·35
	20·86	=	100·00

Several of the largest spangles of gold appeared of a peculiar rich color, owing to their being coated with, as it were, a varnish or thin film of sesquioxide of iron, which persistently adhered to their surface; and, probably, was the source of a part, if not of all the iron found by analysis. This coating was no doubt the cause of the gold appearing to the eye considerably richer than it actually turned out to be, on assay."*

I have very recently washed out about half an ounce of similar gold (only chiefly in larger pieces) from the same locality.

* *Philosophical Magazine, Nov.* 1867.

It is associated with bits of galena, blende, titanoferrite (of Forbes), quartz, marcasite, and fragments of rock-debris.

The iron is removable by a magnet, but particles of gold will also adhere.

Some of this spangle-gold is tarnished as Forbes describes, but it is generally tarnished by titanic acid; and the tarnish is instantly removed by sodium or potassium amalgam, and will then yield to the ordinary processes of amalgamation. Without taking into account the greater pureness of this stream-gold, compared with the electrum of the lode-stuff, I think it more than probable that it did not originate at Tyddyn-gwladus at all. It was more likely brought down by the Mawddach floods from the Gwynfynydd or Cwmheisian mountains, or from still nearer the sources of the Cain and Mawddach rivers.

In my paper on 'Mineral Growth at ordinary temperatures,' already referred to, I have shown, that at times, under apparently ordinary conditions, gold, silver, copper and iron suddenly exude from the surface of the minerals (especially gold from quartz, and silver from calcite and argentite); and this extrusion for convenience of expression I termed 'Mineral Growth.'

The expression does not happen to be generally acceptable to the mineralogical mind; but the metals 'grow' (in the sense I mean it) for all that.

In that paper I referred to a lump of white quartz weighing half a hundred weight, which once occupied a place in a 'rockery' in a fern-corner of my garden.

This stone in December, 1877, shot out a 'crystallized twig' of electrum-gold more than $\frac{1}{16}$ of an inch long in the course of ten days, probably it grew in less time than that.

This, and other 'growths,' fell (or grew) off sometime between the beginning and ending of the observed ten days. In May, 1878, another sprig shot up from the very same spot, and remains thereon, probably to this time. [I loaned the stone to the Liverpool Museum, and have not seen it since]. Similar detachments may account for most of the stream-gold at this place, and, probably elsewhere.

Why the stream-gold of this district contains less silver than the electrum *in situ*, I cannot as yet determine; but the fact is so. Sections of some of the water-worn gold show that *cavities* in them are very prevalent. These, as Forbes suggests, are air-cavities, nearly all of them, and will account primarily for the comparatively low specific gravity of stream-gold, as a rule.

The electrum *in situ* hereabout is most unequally distributed.

It is generally thought that native or free gold never occurs uncombined

with silver, probably this is so. However, free gold frequently contains Fe, Cu, Hg, Pd, Pt, or Ir, or several of them in combination.

The Mawddach stream-gold contains traces of Pt, Ir, and Cu, as well as about 14 per cent of silver.

In some of the pyritous minerals found here, I am certain that the gold does not exist, always, in a metallic state; but that it is frequently combined with Sulphur or Arsenic; or, more or less with both; and occasionally with antimony.

At present, I have detected no tellurides (such as Tetradymite), found so commonly in the Clogau mountain about 5 miles from Tyddyngwladus.

I have several times found spangles of gold at the roots of ferns, growing near the western side of the Mawddach river; and, for more than two miles along the eastern side, a series of shallow pits gave me similar gold at every sinking.

In one place I got several ounces of stream-gold from the margin-dirt.

In the ordinary operation of washing this dirt with the 'batea,' the most 'experienced hand' fails to concentrate the whole of the gold contained in it. There are always mineral admixtures of high specific gravity, such as galena, magnetite, &c.; and, the lighter gold (alluded to above) is always more or less persistent in floating off. So that gold-washing, *per se*, is necessarily attended with great loss of gold (in two ways at least).

Gold-washing in the Mawddach can never be profitable except to 'old hands at it,' on their own account solely, who can conscientiously keep all they may happen to get.

My own trials at it invariably cost me 9d. to 1s. a grain! although the Rhine sand is considered worth washing when containing only 0·00000012 per cent of gold!

The results of two analyses of the Clogau gold, by D. Forbes, are as follows:

Gold	30·69 =	90·16	.. 4·86 =	89·83
Silver	3·15 =	9·26	.. 0·50 =	9·24
Copper and Iron..	trace =	trace	Fe trace =	trace
Quartz	0·11 =	0·32	.. 0·04 =	0·74
Loss	0·09 =	0·26	.. 0·01 =	0·19
	34·04 =	100·00	5·41 =	100·00

Forbes further writes:—

"The metals Au. and Ag. are known to alloy with one another in all proportions, when fused: and, being both monometric in crystallization, are doubtless isometric in their replacements."

"It is interesting, however, to observe that the above analyses closely agree with the formula Au^6 Ag, which, supposing the equivalent of Au. and Ag. to be respectively 196 and 108, would, on calculation, require a per-centage composition of

Gold	90·88
Silver	9·12
	100·00 "*

The most interesting occurrence (from a crystallographical point of view), is what appears to have been a rhomb of chalybite, changed to limonite, &c., around which quartz has commenced to aggregate in a crystalline form.

* The Clogau gold is of a darker color than the Mawddach gold generally, owing to silver and tellurium being replaced by copper. Forbes noticed this himself in a communication to me, and I have often found it so.

Reviews and Notices.

Chapters on the Mineralogy of Scotland, by PROF. M. FORSTER-HEDDLE.

Trans. Royal Soc., Edinburgh, Vol. XXVIII, Chap. IV. Augite, Hornblende and Serpentinous change. Read April 1st, 1878.

IN this elaborate monograph we have another portion of Prof. Heddle's laborious undertaking, which is no less than a complete Mineralogical and geognostic description of Scotland. In the present paper 40 folio pages are devoted to a consideration of Augite from 20 localities occurring in the following situations, in

Granular limestone
Gneiss.
Diallage Rock.
Diorite ?
Hyperite ? } (The queries are Dr. Heddle's.)
Volcanic Rocks of the Coal formation.
Volcanic Rocks of the Old Red Sandstone.

Dr. Heddle gives a useful comparative table of his analyses (Table 1)

He then goes on to the consideration of some alterations of augite into serpentine, pseudo-augite, pseudo-enstatite, pseudo-diallage, totaigite, and Schiller--spar, devoting 10 pages to this part of the subject and giving seven analyses (Table II.)

Having dealt almost exhaustively with the Augites, Dr. Heddle goes on to describe the hornblende occurrences (23 pages), including Amianthus, Asbestus, Tremolite, Actinolite, Edenite, Pargasite and Nephrite—in

Granular Limestone
Diallage Rock
Serpentine
Hornblendic Gneiss
Diorite

His analyses are given in Table III.

He then devotes 12 pages to the description of a number of alteration products of hornblende, such as hydrous anthophyllite, hydrous asbestus, picrolite, baltimorite, chrysotile, hydrated hornblende &c., and includes in the accompanying table (Table IV) analyses of the minerals known as mountain cork, mountain leather, and mountain silk, which he has since included under his new species pilolite.

TABLE I. *AUGITE.*

	S.G.	$\dddot{Si}$	$\dddot{Al}_2$	$\dddot{Fe}_2$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Ca}$	$\dot{Mg}$	$\dot{K}_2$	$\dot{Na}_2$	$\dot{H}_2$	Total.
Malacolite												
Shinness, white	3·15	53·06	·19	1·77	·47	·15	23·63	19·29	...	...	1·546	100·12
Totaig, blue	3·2	50·69	·03	·93	...	·07	25·78	18·09	·5	1·43	2·62	100·12
Ben Chourn, white	3·16	51·59	·11	·33	...	...	22·01	19 59	·49	1·01	4·64	99·75
Glen Tilt, white	3·16	53·24	...	2·71	...	·13	22·77	18 86	...	...	2·18	99 89
Glen Muick, blue	3·18	51·	...	1·37	1·59	·38	26·36	17 08	·63	1·12	·26	99·89
Sahlite.												
Ben Chourn	...	54·48	....	...	3·13	·24	22·82	17·58	·44	·79	·42	99·91
Tiree	...	50 54	4·69	4·14	·08	·69	23 59	14·4	·31	·63	1·48	100 51
Eslie	...	49·5	1·96	...	11·06	·4	24·08	10·81	·57	·8	·69	99·86
Coccolite.												
Gruagach	3·05	49·04	6·09	1·39	2·94	·46	23·34	15·12	·82	·79	·17	100 15
Diallage.												
Balta	2·96	50·23	5·84	...	5·22	...	11·23	21·59	1·2	·58	4·17	100·07
Pinbain	3 25	51·77	2·1	...	2·96	·31	22·1	18·46	·63	·58	1·08	99·98
Augite.												
Glen Beg	3·24	54·22	·17	...	6·7	·4	19·57	16 97	·5	·45	·96	99·96
Halival. Rum	3·48	50·54	3·25	1·34	4·42	·23	21·42	17 05	·25	·53	·71	99 83
Craig Buirock	3·28	50·33	4·48	3·92	5·76	·31	17·57	16·62	·19	·89	·38	100 45
Pseudo-Hypersthene.												
Corry-na-creech, green	3·33	53·05	4·82	...	11·39	·08	19·81	11·58	...	...	·63	101 34
Hart o'Corry, bronzy	3·33	51·36	1·66	...	8·97	·33	20·84	16·47	...	.. ...	·54	100·17
Drum-na-Rabm	3·34	51·94	1·32	...	13 9	·25	19·36	13 85	...	Ti ·38	·2	101 25
Loch Scavig	3·32	49·27	·22	2·17	12·15	·38	20 26	14 81	...	...	·72	99·98
Cuchullins (Muir)	3·34	51·35	...	...	33 92	...	1·84	11·09	...	...	·5	98·70
Skye (Haughton)	...	50 8	3·	...	9·61	1·08	19·35	15·06	...	·66	·6	100·16
Cuchullins (Rath)	3·34	51·30	·76	...	13·92	·25	20·15	14·85	...	...	·21	101·44
Augitic Glass.												
Elie	3·33	49·04	9·71	1·25	5·16	·31	16·25	16·88	·31	·79	·3	100 01
John o'Groat's	3·36	46·08	11·39	..	7·92	·46	16·07	15·65	·82	1·06	·38	99·82

TABLE II.

ALTERATION PRODUCTS OF AUGITE.

CONVERSION INTO SERPENTINE.

	S.G.	$\ddot{Si}$	$\dddot{Al}_2$	$\dddot{Fe}_2$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Ca}$	$\dot{Mg}$	$\dot{K}_2$	$\dot{Na}_2$	$\dot{H}_2$	Total.
Typical Suhlite	...	53·7	...	...	8·	...	24·9	13·4	...	...	...	100·00
Hydration—Loss of $\dot{Ca}, \ddot{Si}$—*peroxidation partial.*												
Pseudo Augite, Portsoy	...	37·33	1·13	4·36	4·05	·38	1·2	36·71	·88	·73	13·37	100·14
Pseudo-Enstatite (?) Green hill	2·16	37·78	2·12	5·07	2·1	·76	...	37·01	tr.	tr.	16·07	100·22
Hydration—Loss of $\dot{Ca}, \ddot{Si}$—*total peroxidation.*												
Pseudo-Dialluge, Portsoy ...	2·62	34·54	1·16	15·2	·33	·28	...	36·38	...	...	12·2	100·09
Pseudo-Enstatite ? Balhammie	...	37·41	...	13·54	·06	·24	·2	34·76	...	...	13·59	99·78
Totaigite, yellow; Totaig ...	...	37·22	·76	...	1·05	·23	5·24	44 97	...	...	10·64	100·11
Do. black	2·87	36·19	·26	·29	2·96	·45	3·27	45·57	·25	·42	10·2	99·97
The same, with no peroxidation.												
Schiller Spar, Black Dog Rock	2·65	38·19	2·18	·07*	8·48	·51	2·91	32·42	1·4	·07	14·03	100·49
Typical Serpentine	...	44·14	...	...	...	...	...	42·97	...	...	12·89	100·00

* $\dddot{Cr}_2$=·28

TABLE III

HORNBLENDE.

	S.G.	$\ddot{Si}$	$\dddot{Al}_2$	$\dddot{Fe}_2$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Ca}$	$\dot{Mg}$	$\dot{K}_2$	$\dot{Na}_2$	Fl	$\dot{H}_2$	Total.
Amianthus.													
Balta	2·95	56·15	1·54	·39	3·11	·77	11·72	22·46	·19	·69	...	...	99·52
Asbestus.													
Shinness	...	56·85	·23	·48	2·12	·23	12·54	23·92	·44	·54	tr.	2·53	99·87
Portsoy	2·99	56 31	·77	·53	2·32	·15	12·58	23 31	·44	·63	tr.	2·94	99·98
Nephrite.													
Balta	2·96	55·73	·05	...	5·2	·01	13·24	22·7	·14	1·12	...	...	100·62
Schistose.													
Leegarth, Fetlar	2·95	56·92	·22	...	4·65	·08	12·32	22·08	tr.	tr.	...	3·4	99·66
Tremolite.													
Shinness	2·96	56·15	·86	1·62	·72	·07	13 31	24·14	·44	·21	tr.	2·5	100·01
Glen Urquhart	...	57·31	6·68	1·08	3·23	·31	12·36	16·62	...	...	tr.	2·5	100·08
Actynolite.													
Hillswick	...	55·	1·51	·99	3·46	·31	10·38	23·31	1·12	1·1	...	2·9	100·07
Edenite.													
Urquhart, green	...	50·31	8·54	·12	2·76	·08	11·63	20·77	·5	1·16	none	4·13	99·99
Do. black	...	51·31	2·21	·16	7·66	·49	11·17	20 87	2·2	·46	...	2·12	99 65
Pargasite.													
Errins	...	52·69	2·56	4·09	9·77	·23	11·42	15·77	·57	·69	...	2·13	99·91
Hornblende.													
Balta	3·11	45·87	8·78	...	14·15	·13	9·82	14·4	·82	1·43	...	2·3	97 7
Fetlar	3·09	41·63	11·63	1·85	8·95	·31	9·25	18·51	·63	1·22	...	...	99·37
Portsoy	3·25	52 07	2·57	...	9·72	tr.	19·05	14·41	·75	·57	...	·85	99·99
Glen-bucket	3·22	45·	9·41	1·55	16·76	·33	11·24	11·19	1 36	1·66	...	1·34	99·85
Durness	...	51·46	2 97	2·45	9·66	1·08	20·07	10·46	·68	1.31	...	·68	100 83
Elie	3 37	40·38	19·01	2·12	7·28	·46	11·54	17·5	...	...	...	1·17	99·48

TABLE IV.

ALTERATION PRODUCTS OF HORNBLENDE.

	S.G.	$\ddot{Si}$	$\dddot{Al}_2$	$\dddot{Fe}_2$	$\dot{Fe}$	$\dot{Mn}$	$\dot{Ca}$	$\dot{Mg}$	$\dot{K}_2$	$\dot{Na}_2$	$\dot{H}_2$	Total.
Hydration, Loss of Ca, peroxidation												
Hydrated Hornblende, Green Hill ...	3·01	50·92	1·89	9·43	2·09	·31	8·65	21·58	·34	·43	4·54	100·17
Hydrous Anthophyllite, Scoorie	2·92	45·51	6·39	...	14·29	...	4·44	22·14	tr.	tr.	6·72	99·44
Mountain Cork, Portsoy	...	51·43	7·52	2·06	2·49	1·3	·58	9·35	...	...	25·04	99·76
Ditto Lead Hills	...	51·45	7·98	·97	3·29	1·49	1·97	10·15	...	..	21·7	99·
Mountain Leather, Tod Head	...	52·48	6·33	·6	2·11	2·88	1·34	11·95	...	...	21·7	99·4
Mountain Silk, Partan Craig	2·11	54·37	11·27	·21	1·09	·33	·98	9·49	...	...	22·41	100·16
Hydration, Loss of Ca and bases—passage into Serpentine.												
Picrolite, Balta...	2·69	50·19	2·1	...	4·39	·01	5·07	29·23	...	·74	8·5	100·23
Do. Serpentinous, Balta	2·63	50·08	1·88	...	6·09	·23	·86	31·57	...	·34	9·3	100·34
Above, with removal of Silica.												
Hydrous Anthophyllite, Urquhart ...	2·81	47·72	3·84	·18	5·74	·16	5·64	28·75	·19	·26	7·65	100·12
Hydrous Asbestus, Portsoy	2·39	46·92	·63	·01	1·67	·77	9·91	25·85	·57	·58	12·84	99·75
Picrolite, Fethaland	2·65	42·93	1·85	5·1	...	·42	·8	36·19	·81	·37	11·5	99·97
Hydrous Anthophyllite, Ayrshire ...	2·81	39·75	·49	5·3	4·11	·23	6·27	26·25	·76	·11	16·83	100·1
Baltimorite, Killin	2·63	41·47	...	4·01	4·83	·26	...	37·14	...	...	12·5	100·2
Chrysotile, Fetlar	...	39·73	·1	...	2·92	...	...	41·61	...	...	15·66	100·02

In discussing the whole series of analyses, especially of the altered minerals, and of the method of serpentinous change, Dr. Heddle observes—

"These results demonstrate that the process of change consisted, in progressive order.

First, in a direct increment of the water.

Second, in a decrement of the lime.

Third, in a gradually increased decrement of the iron.

Fourth, in a decrement of the silica.

In same situations, however, there is no decrement in the iron, but a peroxidation thereof.

What the rationale of the change under the *first* of these heads may be, I could not, in the circumstances of so small an amount of matter to found on, attempt to show.

The circumstances under which some at least of the other changes may be effected we do know; and our knowledge thereof may be grouped under certain heads.

The leading summary of our knowledge may be stated thus:—

The primary agent of change is meteoric water, holding carbonic acid and oxygen in solution.

The secondary agent is spring water, holding less oxygen, more carbonic acid, and certain salts in solution.

The third agent is these same waters, sinking downward or rising upward, but now holding more complex salts—the products of the first operation of the waters themselves,—these salts being the agents of a second set, perhaps an endless cycle of changes, generally more potent than the originals.

As regards the substances operated on, we know that those most easily attacked are carbonates and silicates of the alkalies, the waters thus becoming charged with most potent graving tools.

Next we have silicates which contain lime, protoxides of iron, and of manganese.

Lastly, we know that silicates of alumina and magnesia are the most stable of all; for carbonated water has no action upon silicate of alumina, and but a slight one on silicate of magnesia.

In virtue of the above,—from compound silicates carbonated waters will abstract the silicates of lime, iron, and manganese; leaving the silicates of magnesia and alumina as residues.

In virtue of the above,—the rock masses which we find in nature to be least prone to decomposition, are either immediately silicates of alumina

and magnesia, or they are such as have originated from the alteration of the less stable silicates. Such are—steatite, talc, silicate of alumina, clay, kaolin, and sand itself—among simple silicates; and mica, chlorite, serpentine, asbestus, and mountain leather—among compound ones.

These, however subject they may be to more complex changes induced by saline or alkaline waters, are no longer liable to further alteration through the operation of atmospheric agents—such as oxygen, carbonic acid, and water.

Thus it is, then, that serpentine *asserts itself* wherever occurring; protruding as lines of rugged eminences,—fitter types of the attribute assigned to the "everlasting hills" than the lordlier granitic masses around it; thus it is that the mica crystal, which, torn from that granite, and mechanically comminuted but intrinsically unchanged, has served its purpose of giving continuity and sparkle to sandstone of newer and still newer epoch, glitters yet untarnished mid the sands of the sea-shore; and thus it is that these sands themselves, buffetted by the waves of Cambrian, and Old Red, and Coal Measure, and Permian, and it may be still more recent epochs, amid many surrounding changes have known none, but atomies though they be, seem quite large enough and hard enough again to complete a like extensive cycle.

Thus it is that the clay which, as impure kaolin, the rain drop has gouged out of the felspar of that granite, which, soft as mud, gives way to everything, but can be changed by nothing,—is seized upon by man to be fashioned into a structure, harder, less compressible, more durable than stone itself.

Thus, then, the mere passage of a current of carbonated water over minerals containing, or rock containing lime, iron, and silica, is sufficient to sweep these substances in solution out of the rock, and to do so, moreover, with great rapidity.

It was Bischof who first clearly pointed the potency of carbonated waters in effecting decomposition of rocks containing the substances above noted as soluble therein; and its absolute want of power to remove magnesia from them on account of the insolubility of silicate of magnesia in carbonated waters or even in carbonated alkalies, supposing these to be formed as a first step in such a process.

Hence the direct and unfailing action of such waters upon augitic rocks must be their conversion into serpentine.

It has been shown that inasmuch as carbonic acid does not combine with alumina it can have no power to remove alumina; and so a serpentine formed by the alteration of an aluminous mineral must be a more or less aluminous serpentine. And inasmuch as it is in hornblende and not in

augite that alumina replaces silica, we may if we find, on analysis that a serpentine is notably aluminous, be able to say that it was formed by the transmutation of diorite or other hornblendic rock.

Again, inasmuch as carbonic acid does not combine with the peroxide of iron, if that substance is either present, or once formed in a mineral, it cannot be removed by such a process; and so it is that we have the iron in these serpentinous products unremoved if it be thrown into the state of peroxide.

Its retention as such may even aid us in determining the depth at which the transmutation took place.

If the change was effected near the surface, we know that the transmuting water was aerial,—"meteoric water," as it has been called. Each gallon of such water holds in solution 2 cubic inches of oxygen and 1 of carbonic acid. This water, holding so small a charge of carbonic acid, could only effect the transformation with extreme slowness. We have seen that the lime was removed in the first place; if the quantity of acid did not suffice to remove both lime and iron, during the time that that acid was engaged in taking up the lime, the oxygen in solution would simultaneously be engaged in peroxidising the iron.

So we would be entitled to hold that serpentines with red or brown colours, and such as retained iron as peroxide, had been formed near the surface. So can we explain, also the ferruginous crust which is so characteristic of most serpentines at their outcrop.

Spring waters, again, much more highly charged with carbonic acid, but not carrying so large a supply of oxygen, would effect the change more rapidly, and sweep away, more or less, perhaps all of the iron as protocarbonate, leaving only residual traces of protosilicate, which impart the green coloration.

We have at Portsoy the most direct evidence conceivable of the conversion of diallagic rock into serpentine, in the fact that one end of the stratum still remains as gabbro; and in immediate contact with it we have limestone, here very siliceous. Now, the frequent association of thin beds of limestones with serpentine supplies very direct evidence of the conversion of hornblendic and augitic rocks into serpentine. In that fact we have a ready answer to the question, "What becomes of the carbonate of lime necessarily formed during such an alterative process as the above?"

I will not say that limestone is always to be found in such association; we do not always find limestones even where we have indubitable evidence that they once existed; for here the very thing that makes can unmake, or sweep away. The carbonate of lime thus fashioned out of the rock

forms a belt beneath the residual serpentine, thicker or thinner in accordance with the original thickness of the stratum of transformed rock; also thicker or thinner according to whether that rock was augitic or hornblendic; for the former can supply considerably more lime than the latter. This calcareous belt must lie beneath the parent rock, sealed against any great amount of further change, unless or until upheaval or denudation expose it to meteoric influences. *Then* water, flowing either downward or upward, may—nay, in time must—sweep it away in solution, leaving lime-sink, or collapsed-void to evidence its former existence. But if the limestones, so frequently associated with serpentines, are thus to be assigned to the decomposition of the rock which yielded these serpentines, we have a crucial test of the soundness of the theory of the change, in the inquiry as to whether *unchanged* gabbro, or other such rocks occur in contact with lime.

That it never does, I will not say; but in glancing at a sketch geological map which I have constructed of the district where these rocks occur, I find, as regards the great belt of diorite and diallagic rock which sweeps up central Scotland, that where either the limestone appears in contact with it, or a "wash-out" discloses its former existence, there the rock is serpentine; where it appears as unaltered rock there is no lime.

I find, moreover, that wherever the association can be observed, the lime invariably is beneath the serpentine. So it is with the loch of Cliff lime and the serpentine of Unst; both of the lime and serpentine beds at Polmally; both of the lime and serpentine beds at Portsoy; at Limehillock; Tombreck; the Green Hill of Strathdon; and Beauty Hill; and in enumerating these I have named all the most important masses in the country.

The evidence of our transmuted minerals thus goes a long way to prove serpentine to be a metamorphic, and not an igneous, rock, whether the chemical process proposed in explanation of the *modus operandi* of the change be or be not considered satisfactory.

But there are occurrences of serpentinous matter differently circumstanced, where the above explanation can by no means suffice.

By the dissolving out of the lime from a stratum either of gabbro or of labradoric diorite, we would obtain a great mass of limestone, it is true; but that mass, relatively to the simultaneously formed serpentine, should be comparatively small.

The hornblende of Portsoy would yield equal to about 34 per cent. of carbonate of lime—its labradorite would yield about 20 per cent.; and, as in the diorite rock, the hornblende is to the labradorite in about the proportion of 2 to 1, this rock as a whole would yield about 29 per cent.

of its original bulk; of which, however, there remains still 84 per cent., for 13 of the 29 consist of direct addition of carbonic acid. Here, then, we have a rock yielding by its metamorphoses about one-third of its original bulk of carbonate of lime.

But, in what are called the serpentinous marbles, quite a different state of matters exists. These marbles I know from one part of the bed in Tiree; from Loch Bhalumais, in Lewis; Rodal, in Harris; Dalnein, in Strathdon; Glen Elg; Glen Tilt, and some neighbouring localities. It is of these only I am entitled to speak.

In all, the appearance is the same,—granular imbedded particles of serpentine, from the size of a shot to that of a bean, sparsely sprinkled throughout a great mass of lime, in an amount which is altogether quite trifling

Unhesitatingly I say that these granulars are, one and all, pseudomorphs of pre-existent crystals of augite. That mineral may be seen unchanged and changing in the Tiree marble. In Glen Elg and other localities the pseudomorphic forms are so perfect that the crystalline form of the augite is indubitable.

These trifling specks could never have been the origin of a lime stratum tens of feet in thickness.

I would suggest the following explanation of the serpentinous formation of these pseudomorphs,—which had palpably pre-existed as augitic crystals imbedded in lime.

It is well known that when silica or silicates are heated along with carbonate of lime, there is, in the first instance, a disengagement of carbonic acid and a formation of silicate of lime; or, in the presence of other bases, of more complex silicates. Bischof found this decomposition to take place unfailingly even at the temperature of boiling water. No great depth in the earth's crust would suffice for the attainment of such a temperature. Thus at the point of contact of the lime with the including rock, and also with inclosed siliceous minerals, would there be disengaged the very acid which we have already seen to be the active agent in serpentinous change; and thus also would there be formed new silicates, such as Wollastonite, silicate of lime, and tremolite, which, in fact, are found associated with the pseudomorphs of the serpentinous marbles.

In the outset I directed attention to the fact that serpentines were occasionally formed by the transmutation of such rocks as diallage and diorite *as a whole*,—*i.e.* that the labradoric as well as the augitic ingredient had suffered conversion. The analyses afford one if not two instances of such conversion, and I now instance another which may be a case in point.

Beauty Hill, to the north of Aberdeen, is composed of serpentine, and in small quarrys on its north-east side it will be seen to be as distinctly bedded a rock as any recognised sedimentary deposit.

On its eastern slope some masses of gabbro protrude through the sward of a field. This gabbro is, for the most part, unaltered. It consists of dark somewhat granular crystals, apparently of augite, of the size of large shot, which are imbedded, singly or separately, in a waxy-looking massive labradorite.

In this rock a vein of a pale sap-green mineral was found by Professor Nicol and myself. This was set down by my friend as precious serpentine; to me it appeared somewhat too hard for this, as it cut with less ease than slate-pencil. It was translucent, tough, and had a specific gravity of 2·59.

On analysis it afforded—

Silica	34·731
Alumina	12·444
Ferrous Oxide	2·684
Manganous Oxide	1·17
Lime	1·595
Magnesia	34·098
Water	13·1
	99·822

Now this is precisely the composition of the massive variety of penninite which, from its resemblance to serpentine, has received the name of pseudophite. But it may also be regarded as a highly aluminous serpentine; for if that earth be abstracted the residue is just serpentine. The point of interest which attaches to this substance is, that although it formed a true exfiltration vein in the rock; if the rock in contact with the vein be examined, *the waxy labradorite is also seen to pass, within a space of about an inch, into this mineral by insensible gradation.* So it matters not whether it, in a systematic arrangement, be consistently classed with penninite or not, it is here unquestionably a transmutation product, the result of a serpentin*ous* change of the labradorite.

The *modus operandi* of the change of felspar into serpentine is much more subtle than that of the conversion of augite, and also, it must be said, much less certain. As labradorite contains much alumina, and no magnesia, we have in *its* serpentinous change, to account for the removal of alumina and the direct insertion of magnesia. The term "magnesian process" may with perfect fitness be applied to such a change.

Such an action as that above shown to suffice for the transmutation of augites could not in any degree effect a similar change in labradorite;

carbonated waters do not affect silicate of alumina, and carbonated waters cannot directly purvey magnesia.

It is true that immediately over the bed of serpentine at Portsoy which evidenced such a change, there is a washed out bed of *something*, and it might be argued that that something had been dolomitic limestone; which would yield bicarbonate of magnesia to waters passing through it;—which bicarbonate of magnesia, by a recognised interchange with silicate of lime, would yield silicate of magnesia. To such a view it has to be replied, first, that there is no evidence that the removed stratum was limestone,—the rock immediately beyond the void is a perfectly unaltered diorite, which therefore could not have supplied any lime;—secondly, that in Scotland at least, the limestones associated with serpentine are not dolomitic; and this because, according to the opposite view, the magnesia is retained in the resultant serpentine;—and lastly, that there is no provision, according to such a view, for the removal of the alumina.

For aid in the explanation, we must ascertain what are the circumstances in which silicate of alumina can either be decomposed or dissolved; and what those in which silicate of magnesia can in any way be introduced; we will then be in a position to say whether any of the said circumstances, in the case in question obtain.

Silicate of alumina can be decomposed by chloride of magnesium or sulphate of magnesium in solution,—silicate of magnesia being formed.

Silicate of magnesia, again, is also formed by the decomposition of bicarbonate of magnesia, by silicate of lime, or by silicates of the alkalies.

Now the two first of these salts are present in river water, more largely in spring water, and most largely in sea water; while bicarbonate of magnesia is very frequently present in spring water. Though it is unnecessary to call in the operation of sea water, in the presence of the fact that the waters which permeate all rocks are themselves charged with these potent agents of perpetual change, still, seeing that the altered rocks in question have been beneath the sea, and that their inmost pores would then be more urgently saturated by hydrostatic pressure, it may be very fittingly argued that diallagic rocks which have their felspar as well as their augite converted into serpentine, suffered the alteration during an epoch of marine submergence.

Bischof writes: "It would be very illogical to suppose that the calcareous and magnesian salts dissolved in sea water do not take part in chemical alteration, when it is so manifest that alteration is effected by these salts dissolved in much smaller quantity in the water percolating through rocks. It would be inconsistent with the relation of mutual compensation perceivable in all natural phenomena to suppose that saline

substances were continually carried into the sea, without being consumed in the formation of new substances." To apply this to the present case, there would seem to be no readier way of accounting for the abstraction of the vast quantities of magnesian salt present in the sea, and constantly being added to it, than to use it up, so to speak, in the formation of serpentine. How else abstract so soluble a salt as chloride of magnesium? Its extreme solubility and deliquescence would negative its being abstracted through the direct formation of minerals; but, in virtue of the above interchange, lime salts replace it in the ocean, to be continuously removed in turn by crustaceans, mollusks, and coral insects.

Serpentines, as a rule, are denser, more solid,—give fewer and feebler evidences of being the result of change effected upon pre-existent rocks when examined *in their depths* than on the exterior. Without entering upon the many and complex reactions which take place as secondary results of the interchanges already noticed, it may be sufficient to show that the products of surface change, as they percolate through the deeper portions of a rock, may effect a somewhat dissimilar change therein, and may also in their passage through these rocks, plug up their pores.

Silicate of lime, formed by the action of meteoric water in the superficial portions of a rock, and meeting with magnesian salts within, would by interchange supply serpentinous matter in the solid form to the more porous portions of the deeper-seated beds, to render the whole mass more uniform in structure, while it might also therey be diversified in colour.

When we remember that the decomposition of both augite and labradorite is effected through the operation of what may be called the ordinary agents of exposure—carbonic acid, oxygen, and water—but that, in virtue of their difference in composition, the nature and rate of the decomposition varies, it is easy to explain how it is that the crystals of labradorite are protuberant from the general mass of the augite at Lendalfoot, while at Pinbain the augitic crystals stand in high relief above the felspar in that wave-washed situation.

Augite, containing iron in the state of protoxide, most prone to higher oxidation, rapidly and readily gives way when subjected alike to aërial exposure, where oxygen, carbonic acid, and water are free to operate upon it. Labradorite, containing little or no protoxide, is subject to the operation of the two last only, and so, in the air, is more enduring. When plunged beneath water, however, the oxygen is in great part shut off from the augite, which is thus protected; while here, the labradorite is subjected to the attack of water upon its alkaline silicates, suffering thereby rapid degradation."

After some pages of descriptive Geognosy, Dr. Heddle discusses the mutual associations of hornblende and augite.

"Turning our attention next to the modes of occurrence and lithological associations of the unaltered varities of augite and hornblende, the first direction our inquiry must take is as regards any evidence the analyses may afford, bearing upon the union of the two species into one.

It may be at once conceded that this question cannot be decided by any merely chemical evidence; the wide range of composition, hardly referable to anything closer than a general formula in either mineral, precludes such an hope. The little information that we do obtain tends in the direction of the separation of the two; it consists in this, that in what may be designated as "recognised individuals" of the hornblendic type we have here and again a distinct replacement of silica by alumina; and this we have not in recognised individuals of the augitic type.

Passing from this to the lithological information, we find that a consideration of the records above made by no means tends to strengthen certain of the lines of demarcation which have been drawn between them.

Put in a general form, two of these lines are thus defined: "These two minerals occur in distinct geognostic positions. Hornblende in rocks containing quartz or free silica, and mostly with minerals that are neutral compounds of silica, as orthoclase and albite. Augite in rocks that do not contain free silica, and mostly with minerals that are not neutral silicates, as labradorite, olivine, and leucite.

"Hence, there are two distinct series of igneous rocks; the hornblende series, including granite, syenite, diorite, &c.; and the augite series, or hypersthene rock, gabbro, dolerite, &c.

"In some rare instances these two minerals have been found together, either regularly conjoined or in distinct conditions."*

Here we have it clearly laid down that two "distinct series of igneous rocks" are established on the specific distinction between the two minerals; and secondly, that one argument for these minerals being themselves distinct is to be drawn from the fact that they are associated in but "rare instances."

It would appear at first sight to be an easy matter to enter at least upon the consideration of questions couched in language so precise as the above; but it proves to be not altogether so.

* Nicol's "Manual of Mineralogy," p. 208. An epitome of the views of Gustav Rose.

We have it *first* laid down here that hornblende occurs in rocks with free silica, and along with orthoclase and albite.

Secondly, that augite occurs in rocks devoid of free silica, and,—in contradistinction to hornblende,—along with labradorite, olivine, &c.

Thirdly, that the hornblendic series of rocks,—granite, syenite, diorite,—are "distinct" from the augitic series,—hypersthene rock, gabbro, dolerite, &c.

Fourthly, that the two minerals, on the distinctiveness of which the above separations have been made, occur together in rare instances."

Dr. Heddle then gives examples shewing that postulate No. 1, is contradicted almost everywhere in Scotland, and postulate 3 and 4, very frequently, while postulate 2 is almost always true. He adds, "My own opinion is,that through insensible gradations—intermediate varieties—augitic and hornblendic rocks pass into one another more frequently than is imagined. The two minerals also, in certain circumstances, are so very similar that I do not believe that any mode of discrimination which can be applied in the field, or any more expeditious than the reflective goneometer, can serve to determine them; so that defective nomenclature may have been the cause of the drawing of too sharp a line of demarcation between the rocks which contain them."

The author concludes this most important contribution to Mineralogical literature as follows.

"One other point calls for brief notice,—the question as to augite being a volcanic or fusion-form of hornblende. It will be seen above that both of the minerals occur in granular limestones; these afford very distinct evidence of the operation of great heat.

Again, it will be observed that both occur together in the basalts and dykes of Elie and Kinkell; in these the one mineral—the augite—has undergone fusion; while the other—*the more fusible*—appears unchanged. This circumstance becomes a strong argument in favour of the latter having been formed *in situ*,—*i.e.*, after the eruption and cooling of the containing rock,—an exfiltration product in fact.

Here it may be the case that the fused augite has at one time been formed from hornblende, but the two could not here have been erupted together; so that no direct evidence is to be gleaned from this apparent paragenesis in space, which palpably was not a paragenesis in time."

The monograph will well repay every mineralogist and geologist who shall study it in its entirety.

The White Mineral of the Fossil Plants, from the Tarentaise (*Min. und Pet. Mitt, Tschermak, Band II, p.* 191).—The peculiar silver-like shining covering of most of the plant fossils included in the carboniferous shale of Westphalia has not yet been carefully investigated, and its similarity to the substance forming the Graptolite petrifactions, first described by Gümbel and more extensively by Köbell, induced the present investigation—a peculiarly rich piece of the substance offered the opportunity of making an exact analysis.

This delicately scaly mineral is, like that associated with the Graptolites, not distinctly crystallised, but found only in little thin scaly leaves: these are fissile, somewhat elastic, flexible, soft, white, of a pearly lustre; fatty, talc-like to the feeling. Hardness=1, Sp. Gr.=2·8. Before the blow-pipe in melting exfoliates in a cauliflower-like mass similar to Pyrophyllite, and with cobalt solution gives a deep-blue color. In test tube yields water; not entirely dissolved by sulphuric acid. The purest material chosen with the greatest care under the lens gave the following analysis (A); there are also given analyses of the clay-slate of the Tarentaise (B), of Gümbellite (Köbell) (C), and lastly, of an additional Graptolitic mineral from Gräfenthal in Thuringer Wald (D).

Constituent Parts.	A	B	C	D
Silica	49·710	56·80	50·52	52·50
Titanic Acid	1·035	6·70	...	1·00
Alumina	28·620	25·45	31·04	29·50
Oxide of Iron	2·688	3·05	3·00	3·00
Oxide of Manganese	trace	...	...	...
Lime	trace	trace	...	...
Magnesia	1·600	1·03	1·88	1·16
Potash	6·803	4·20	3·18	5·06
Soda	2·208	1·36	...	
Water and Ash	7·384	8·00	7·00	7·75
	100·048	100·59	96·62	100·47

From the analysis the substance therefore approaches pyrophyllite. The similarity also of the analysis of the clay-slate in which the plant remains and the whole mineral lie imbedded, appears to show that the substance contained in the bituminous shale, during a process favourable for the formation of the mineral is forced into the cavities originated by the carbonisation of the substance of the plant. In fact, in sections perpendicular to the cleavage plane, it is observed that the slate consists of transparent, extremely thin layers strongly affected by polarised light which appear as minute bands, or bands with lens like thickenings: with them alternate others wanting in

transparency, from masses of carbon or dust-like matting which are less distinctly doubly refracting. The chief mass of the slate consists accordingly of a substance very similar to that of the petrified plants. In sections parallel to the cleavage plane, they exhibit defined circumscribed layers clear as water, and doubly refracting, alternating with carbonaceous borderings and dust-like, cloudy, non-transparent spots, with indefinite optical relations. Of the transparent parts only a small portion is not doubly refracting. What is particularly interesting is the abundance of long, not exactly straight black needles resembling the Trichetes observed in clay-slate, roof-slate, and Phyllite. In addition, small transparent crystals show themselves, which exhibit bright colours in polarised light, and appear also to belong to the white mineral.

T. A.

URISITE—A. FRENZEL (*Min. und Petr: Mitt*; *Tschermak*, 1879, p. 133.) In an article on the "Minerals of the Caucasus," A. Frenzel draws attention to a new mineral named by him Urisite, and having the following peculiarities: color from citron to pomegranate-yellow; streak, ochre-yellow; soft; sp. gr. 2·22. Found in nodules and pulverulent, nodules yield to pressure by the finger, when a feeble lustre accompanied by a faint metallic glance is observed, dependent upon minute crystalline surfaces.

Urisite consists entirely of minute rhombic crystals such as Breithaupt has already observed in the similar mineral Raimondite. The crystals appear under the microscope broadly columnar; sharp-angled and well-formed, exhibiting frequently by combination $\infty\breve{P}\infty$. $\infty\bar{P}\infty$. ∞P. $\bar{P}\infty$. P. 0P. The basal plane is occasionally absent: sometimes at one pole the basal surface is very great, at the other small or apparently not developed; so that the crystals then appear hemimorphous. Beneath the microscope the Urisite crystals appear transparent; the mineral has, after the deduction of 3 p.c. of an insoluble residue, the following composition:—Sulphuric Acid, 42·08; Ferric Oxide, 21·28; Soda, 16·50; Water, 19·80.

Sulphur is present in small quantities; and traces of carbonate of lime and talc exist. The ascertained composition corresponds to the atomic relation Fe_2O_3, 2 Na_2O, 4 SO_3, 8 H_2O, and this formula to

Fe_2O_3	160	21·39
2 Na_2O	124	16·58
4 SO_3	320	42·78
8 H_2O	144	19·25
	748	100·00

The result of the analysis thus corresponds almost exactly to the calculated composition, and Urisite stands near to Bartholomite.

T. A.

Milarite,—E. Ludwig (*Tschermak, Min. und Pet. Mitt.*, 1877).—This mineral has only been twice analysed, but with such varying results that a repetition of the investigation was absolutely necessary, and was rendered possible by the author having received about 2 Grams of a picked, well-formed, and perfectly transparent crystal of this rare mineral.

Milarite gives off water on being heated and continues to do so when the finely powdered mineral is heated in the platinum crucible for half-an-hour in the Bunsen flame, the mass becoming only slightly ash-like. In the hot blast of the blowpipe flame no marked diminution of weight is observed after heating, but a perfect fusion occurs, and if after this it is allowed to cool by degrees a transparent colorless glass-like mass is obtained not perfectly soluble in hydrochloric acid. Concentrated fluoric acid in the hot water bath dissolves the finely powdered Milarite in a short time.

A quantitive analysis gave the following results :—

	I.	II.	III.	Average.	Calculated.
Silica	71·85	..	71·88	71·81	72·66
Alumina	10·74	..	10·61	10·67	10·39
Lime	11·58	..	11·71	11·65	11·30
Magnesia ..	trace	..	..	trace	..
Potash	..	4·86	..	4·86	4·74
Soda	..	trace	..	trace	..
Water	1·35	..	1·38	1·36	0·91
				100·35	100·00

The calculated values correspond to the formula $HK, Ca_2, Al_2, Si_{12}, O_{30}$.

These results agree closely with those of Finkener, who probably did not possess an entirely pure mineral (the deviations being explicable by a small admixture of felspar.)

The crystalline form of Milarite as known to Kengott was described as an hexagonal combination of a prism and a pyramid of the second order. According to Tschermak's investigations it must now be referred to the rhombic system, the crystals being penetrative twins, similar to those of Chrysoberyl and Aragonite.

T. A.

ACCIDENTAL COLORS OF ZEOLITES.—WEBSKY (*Berlin*)—*Zeitschrift fur Kryst. und Min., B. II, P.* 517.)—In addition to the red coloring matter of the Zeolites of Dumbarton and of Fassa, colors occur which are dependent on organic substances, as for example those of the Desmin and Heulandite in the magnetic iron veins of Arendal, in which also asphalt is met with. To this second class also belong the colors of the Zeolite lately discovered in the drusy cavities of the granite of Gräben at Striegau. At this locality Desmin of a pale leather-brown colour is of frequent occurrence. Chabazite, of a chestnut-brown hue, passing into orange-red frequently in the centre of the purer crystals is much rarer. The latter on heating becomes dark and a small quantity of tar-like substance distils off. The rare Heulandite of this locality is bright citron-yellow, whilst that of the rarely found laumontite is colorless. It appears, therefore, these chemical combinations though so similar in composition, possess very different capabilities for the reception of coloring organic matters. As to the origin of the latter, in this instance, it may be explained by the assumption that the Striegau granite is a metamorphic formation.

T. A.

APOPHYLLITE FROM HIMMELSFÜRST MINE, NEAR FREIBERG.—(*Neues Jahrbuch für Mineralogie*, 1879.)—Prof. Weisbach has lately described the occurrence of apophyllite near Freiberg. Zeolites, as is well known, have frequently been found in mineral veins, and especially silver lodes; for instance, at Andreasberg, Kongsberg, and Guanajuate; but none had been found at Freiberg till recently. In December last, at a depth of more than 500 yards, in driving a level, a little cavity or "vugh" was met with in the gneiss immediately adjoining a silver lode. The "vugh" contained crystals of quartz, and on these were crystals of calcite, surmounted by apophyllite.

C. L. N. F.

Obituary.

BERNHARD VON COTTA.—This distinguished geologist and mineralogist died at Freiberg on the 14th September, aged 71. He was elected a corresponding member of this Society on the 2nd June in the present year. His memory is dear to many of our members who have had the advantage of studying under him at Freiberg.

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OF THE

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